National Institute of Standards and Technology

NIST

Advanced Measurement Laboratory and Maintenance Priorities Update

February 1999

U.S. Department of Commerce ■ Technology Administration

Advanced Measurement Laboratory and Maintenance Priorities Update

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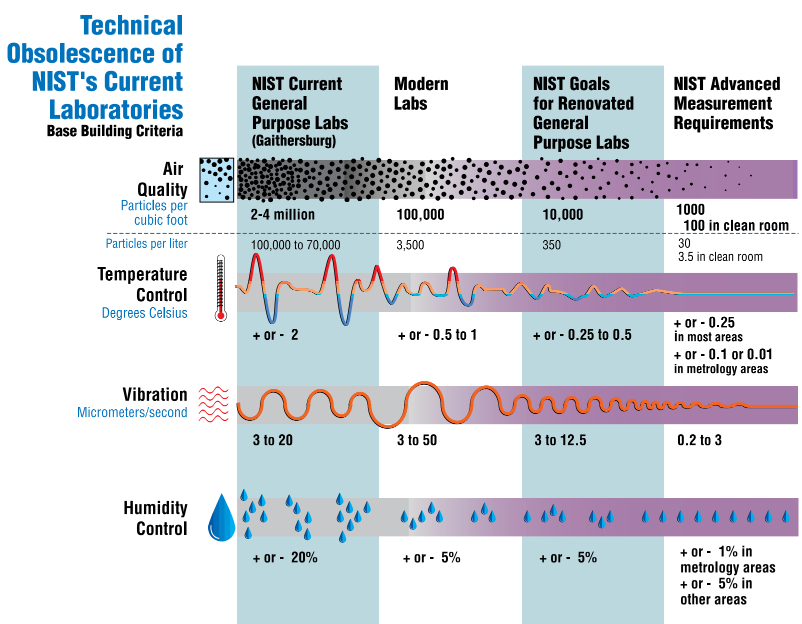
Executive Summary

The research facilities of the National Institute of Standards and Technology are deteriorating at an accelerating rate. As part of a long-term plan to remedy the technical obsolescence of these facilities, NIST has proposed construction of an Advanced Measurement Laboratory (AML). A design for the building was completed in 1996 with $17 million. A total of $203.3 million is needed for construction. NIST has received $108.3 million of this amount in previous appropriations, and the President's FY 2000 budget requests $95 million. An additional $15 million will be requested in FY 2001 for post-construction, fit up, relocation, and communication costs.

This report provides an updated assessment of NIST technical needs for the AML, as well as a funding and construction plan in response to a congressional request for this information. In addition, the report provides updated information on NIST’s plans for safety, capacity, maintenance, and major repair projects consistent with the FY 2000 budget request. (See Appendix A.)



In 1997, NIST contracted for both a detailed technical needs study and a business case analysis to review its plans for building the AML. Both studies recommended that NIST build the AML without delay. Since then, no fundamental shifts in NIST's research needs have occurred. The AML and the stringent environmental controls for laboratory work it would provide remain an urgent priority for NIST’s Measurements and Standards Laboratories.

NIST's spending and construction plans for the AML project appear on pages 6 and 7. The project would require budget appropriations as described above with outlays ranging from $240 thousand to $67.5 million for fiscal years 1999 through 2005. If the pre-construction were started in FY 1999, it would be ready for occupancy by FY 2004.

Introduction

The Commerce Department's National Institute of Standards and Technology serves as the nation’s central measurement laboratory on behalf of U.S. industry and science. Among its other responsibilities, NIST develops the measurement methods, standards, and testing procedures that serve as the fundamental scientific underpinning to many of the nation’s critical technologies, including semiconductor electronics, manufacturing engineering, advanced materials, biotechnology, and information technology. NIST’s mission requires it to perform world-class research, which requires world-class laboratories. NIST’s outdated and deteriorating laboratory facilities are undermining its ability to promote U.S. economic growth and international competitiveness. (For a more detailed description of NIST’s mission and its current facilities, see *NIST Facilities Improvement Plan*, Feb. 1998.) The principal problem is a lack of high-quality systems to control the laboratory environment so that scientists can make precision measurements under stable conditions with tight control of vibration, temperature, humidity, air cleanliness, and electrical power quality.

Some progress has been made to address these needs. An Advanced Chemical Sciences Laboratory (ACSL) has been built and will be ready for occupancy early in 1999. The ACSL will provide substantially better air-quality, humidity control, and temperature control for a majority of NIST chemical science laboratories. It will not, however, provide the very tight levels of vibration, humidity, temperature, and air quality control needed for NIST’s most technically demanding projects in support of industry and science.

A House of Representatives report accompanying the Fiscal Year 1999 Omnibus Appropriations (Public Law

105-277) required NIST to provide its current requirements for an Advanced Measurement Laboratory (AML), as well as a realistic funding profile and construction schedule. This report was prepared to address this requirement. In addition, this report includes a description of NIST's current spending plans for safety, capacity, maintenance, and major repair projects for $10 million appropriated in 1998 to be spent in FY 1999 and for the FY 2000 budget request.

Advanced Measurement Laboratory

Since 1991 and the first detailed assessment of NIST's long-term facilities needs, it has been clear that no currently existing building on the Gaithersburg or Boulder campuses or elsewhere can be retrofitted economically to the high levels of environmental control needed by NIST's most advanced physics, chemistry, electronics, engineering, and materials science research projects.

Individual labs operated by U.S. industry or other government agencies may have substantially better air quality, temperature control, vibration isolation, power stability, or humidity control than current NIST facilities. However, few have strict control in all of these areas simultaneously as NIST needs and plans through construction of the AML. (See Technical Obsolescence Chart on page 1.)

It is not possible to retrofit economically an existing building to meet the exacting requirements of NIST's most advanced research due to the need for:

- extremely low levels of vibration (a velocity amplitude of 3 micrometers per second or less);
- large volumes of air to produce the necessary temperature control of ± 0.25 degree Celsius or better;
- very good air cleanliness (1,000 particles per cubic foot/350 particles per liter or less); and
- excellent humidity control (to ± 1 percent in advanced metrology areas).

The current ceiling heights in all of NIST's General Purpose Laboratories are set by the structural frames of the buildings. There is no room within the confines of the set floor-to-floor heights to include enough new air-handling equipment to reach the required temperature control and air-quality levels. While some improvement in vibration levels is possible through isolation of mechanical equipment in a retrofitted building, the exceptionally low levels needed for NIST's atomic-based measurements require a building specifically designed to achieve this goal.

Both a 1997 technical needs study by SHG Inc. and a business case study by Booz·Allen and Hamilton Inc. compared various facility alternatives and recommended that NIST build an Advanced Measurement Laboratory without delay.

Since these studies were completed, no fundamental shifts in NIST's research needs have occurred. NIST's most advanced research continues to suffer from the lack of adequately controlled environments. While individual research topics continually change, the fundamental need for the Advanced Measurement Laboratory and the advanced environmental control systems it would provide remains an urgent priority for NIST's Measurement and Standards Laboratories. Technologies ranging from medical devices to semiconductors are becoming progressively smaller and more precise, which in turn requires more rigorous laboratory space.

Below are specific examples of how NIST's deteriorating physical facilities are hampering its mission to provide U.S. industry, other government agencies, and university researchers with the best possible measurement system. Research groups working in these areas currently are slated to be included in the AML once it is constructed.

- The semiconductor and chemical processing industries need subnanometer-level reference materials for measuring silicon wafer contamination and for studying catalytic surface reactions. NIST has the instrumentation available to make these measurements but cannot develop them due to poor temperature, vibration, and air-quality control in its laboratories.
- Nuclear facilities, pharmaceutical companies, aerospace industries, and others are pressing NIST to improve the accuracy of its mass calibrations. The lack of good environmental controls in NIST's current General Purpose Laboratories causes NIST's precision mass calibrations to be four to 10 times less accurate than they should be to keep up with the latest commercially available mass measurement tools.
- The aerospace, semiconductor, pharmaceutical, and other high-tech industries need high-quality pressure calibrations from NIST. Many of these measurements are delayed in delivery due to poor temperature and vibration control that prevent NIST's best calibration instrument from being used about one-third of the time.

- Challenged to produce parts with ever more complex features, within ever finer tolerances, manufacturers are relying increasingly on coordinate measurement machines (CMMs)—robots that inspect the dimensions of parts. Despite expensive retrofitting to provide the best possible environment for NIST's most precise CMMs, the instruments could make measurements nearly 10 times more accurately in a more tightly controlled environment, allowing NIST to significantly improve its responsiveness to industry's accelerating needs.

- Thin-film Standard Reference Materials needed by the semiconductor industry to ensure the highest standards of quality control during fabrication cannot currently be made at NIST due to a cleanroom facility that is far behind accepted industry standards for cleanliness, temperature, and vibration control.

- NIST's research on ferroelectric oxide thin films important in lightwave communications networks and next-generation optical computing is frequently set back by dust particles that ruin delicate samples and is limited by temperature and vibration control problems that prevent needed studies of holographic properties of these films.

- Experiments in atomic nanostructures, important for nano- and microprobe instrumentation, high-performance magnetic materials, and magnetic and optical data storage are compromised seriously by swings in temperature and humidity, environmental noise, and vibrations.

- Studies with very high-speed lasers that may lead to more efficient ways to catalyze chemical reactions and to build billionth-of-a-meter-scale structures are hampered by problems with environmental controls that regularly stop work for hours at a time and consume limited operating funds for specialized equipment that only provides limited improvement in environmental control.

- Measurements of dopant concentrations with a spatial resolution of 10 nanometers are needed by the semiconductor industry for quality control of devices expected to be available early in the next century. But NIST research to calibrate a new instrument capable of this resolution is being delayed by uncontrollable shifts in temperature and humidity and by poor air quality.

- Precision measurements of surface shape are critical to ensuring the performance of advanced optical surfaces such as focusing mirrors used in astronomy and the manufacture of next-generation semiconductors. The lack of highly stable laboratory environments soon will make it extremely impractical, if not impossible, for NIST to provide these measurements with the increasingly high accuracies required by its government and industry customers.

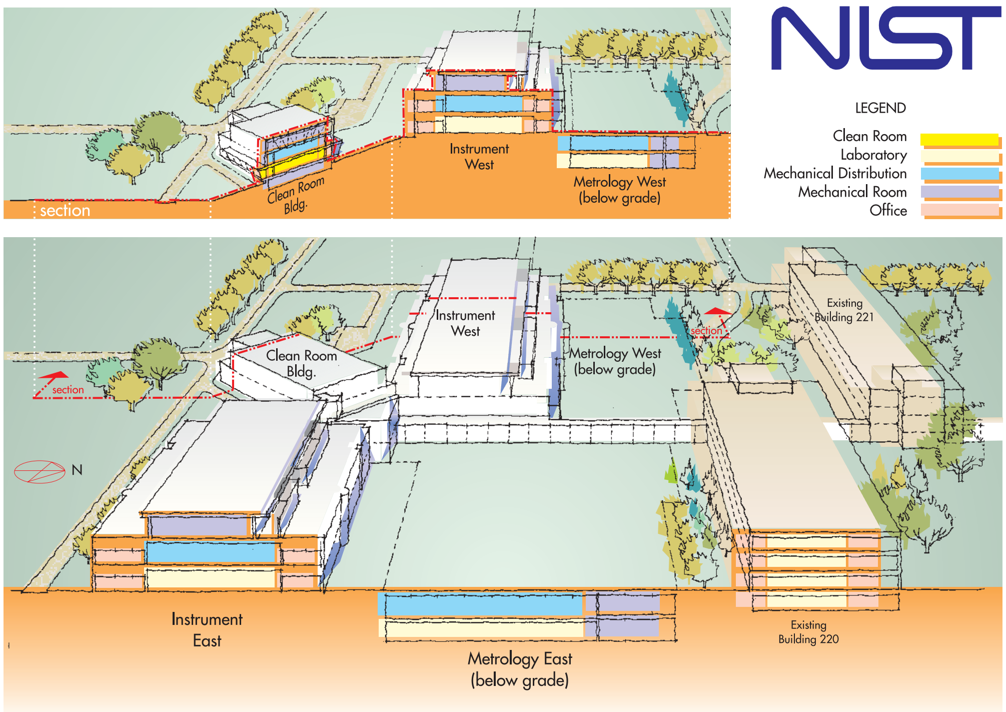
As these examples illustrate, many NIST researchers in advanced technology areas currently must throw out or delay 10 to 30 percent of their measurements due to unacceptably large variations in environmental conditions. The improved vibration, temperature, electrical power, humidity, and air-quality control of the AML will improve greatly the efficiency, quality, and range of precision measurements that NIST provides to U.S. industry and science.

Current Status

With facilities appropriations received to date, NIST has completed an architectural and engineering design and supporting research for the AML at a cost of $17 million. This design requires some revision to take into account certain updated safety features, code requirements, and some minor research-driven changes. In conjunction with building consultants HDR Inc. and vibration experts Acentech Inc., NIST has conducted detailed experiments in temperature and humidity controls and in vibration isolation. It also has constructed full-scale mock-ups of laboratory and office modules on the Gaithersburg campus to test and improve critical elements in the design of the AML. The design process has included participation by key NIST scientists who are experts in building environmental controls as well as researchers expected to be users of the new building. The information gathered through these studies has greatly improved confidence that the building can meet its ambitious design specifications.

NIST's plan is to build the AML in a single phase beginning in FY 2000, and to complete it in 44 months at a total remaining project cost of $218 million. For construction of the AML, NIST plans to use an integrated project team of government staff and contractors to manage this project.

To better focus on value and mitigate risks to the government, NIST generally prefers to select the construction contractors via a Request for Proposal (RFP). Under the RFP approach, risk will be managed through a formal risk assessment process whereby each bidder will be evaluated against the quality of its reference check results, past performance information, experience, financial soundness, and current vs. historical work backlog. Integrated project teams, consisting



AML function and capabilities

NIST **Advanced Measurement Laboratory,** Gaithersburg, Md

JACOBS ENGINEERING GROUP INC.

of experts in all pertinent disciplines, will participate in the evaluation of proposals and award decisions. Construction contract documents for this project will include detailed construction specifications and drawings, and all contracts are planned to be of the firm fixed price type. The contract will require the contractor to adhere to a contract schedule that will be used as the basis of payment for work in place.

To lower appropriations needed in any one year, NIST considered the option of phased construction of the AML in three self-sustaining sections. While technically feasible, this option has a number of substantial drawbacks, including additional cost. Phasing construction would require a substantial redesign. Phasing also raises the cost of AML construction to $283 million (FY 1999 dollars) and extends the completion date about three years. Since the building consists of five independent wings (see AML drawing above), excavating and laying foundations for each subsequent portion of the building would be much more difficult, expensive, and disruptive to important ongoing research than if underground wings and adjacent foundations were constructed at the same time.

Booz·Allen analyzed both the single-phase and a three-phase AML alternative. They concluded that the $218.3 million AML cost estimate was within a reasonable range, and they also concluded that the three-phase alternative would increase total costs by $50 million to $90 million, consistent with the above. “Thus,” it concluded, “our recommendation is to construct the AML in a single phase.”

The AML is designed to be a shared resource for NIST and the industrial and scientific community that works closely with NIST. Research groups from any of the NIST laboratories may be assigned space in the AML if they have a technical need for tight environmental controls. Currently, the programs with the greatest need for AML space are research areas such as precision engineering; atomic-scale physics; microchemical analysis; microelectronics processing and materials analysis; acoustics, mass, and vibration measurements; pressure and temperature measurements; chemical kinetics; and photonic materials. With the evolution of technology to smaller, faster products, however, the demand for the limited AML space should continue to increase.

The AML will include five different sections joined by a central corridor that connects them to the current Metrology Building. There are two different metrology sections in the planned AML. “East Metrology” includes those areas of atomic physics, mass measurements, or other research that require excellent isolation from vibration sources as well as good air quality and temperature and humidity control. The "West Metrology" section will include NIST research and calibrations using coordinate measuring machines and other metrology instruments that need good vibration isolation and temperature control but that also create some vibration due to the fact that parts of the machines must move while measuring artifacts.

Vibration

Very strict attention will be paid to maintaining good vibration isolation for these metrology spaces. Both metrology sections will consist of single floor buildings constructed entirely below grade level. The roofs of these areas will be covered with soil to minimize disturbance to the building from wind and vibrations transmitted through the soil. The space above the metrology area will be planted with minimal care shrubbery and reserved as a quiet zone. Building mechanical systems such as motors, air-handling units, and uninterruptible power supplies will be isolated from these areas. Even refrigerated vending machines, which have been shown to generate significant vibration in laboratory settings, will not be allowed in these areas.

In addition to the above measures, the AML metrology laboratory spaces will include several types of vibration isolation foundations. Measurements made in a mock-up foundation lab constructed at NIST have provided detailed information on the benefits of different vibration isolation schemes. These experiments have included comparing vibration isolation at various frequencies for isolated concrete slabs, concrete slabs floated on air springs with passive vibration controls, and concrete slabs floated on air springs with active computer-controlled cancellation of vibration. The results have shown that for certain highly demanding research areas, active canceling of vibration offers the best achievable vibration control. In an effort to constrain costs as much as possible, foundation air springs will be included as an option rather than in the base AML building design. Nevertheless, the building will be designed so that certain laboratories may be retrofitted economically for air springs should funding become available in the future or if bids for the base building are lower than anticipated.

The AML also will include two sections of Instrument Laboratories. These will each include one floor of laboratory space, above ground, on well-isolated concrete slabs on grade. Both sections will house research projects that use a wide variety of electron microscopes, laser/optics equipment, high-vacuum chemical reactors, and other instruments requiring stringent vibration control and excellent temperature, humidity, and air-quality control. Adjoining the instrument labs will be two floors of office space for researchers working in the AML.

Cleanroom

Finally, the AML will include a cleanroom section that offers one floor of above ground laboratory space. The cleanroom will be similar to those certified as class 100 with 3.5 or less particles per liter. While this is not as good as current high-performance industry semiconductor fabrication facilities (typically class 10 or better), the AML cleanroom will be adequate to perform the measurement R&D required by NIST programs. Areas of class 10 space will be achievable in the AML cleanroom through dedicated enclosures, so that this level can be reached when necessary. In addition, the AML cleanroom will be designed to be upgradable to class 10 in the future, should the need arise. The cleanroom will house projects by research groups in semiconductor processing, materials evaluation, and length measurement. It also will be used for sample preparation or fabrication needed by many groups housed in the adjacent metrology and instrument laboratories of the AML. For a more detailed description of NIST's cleanroom requirements, see *Cleanrooms in NIST's Programs — Review and Analysis,* February 1999.

High-Bay Areas

To accommodate larger laboratory instruments, AML laboratory modules can be adapted to ceiling heights as high as 7 meters (22 feet). This adaptability stems from the fact that mechanical systems will be isolated above the ceiling or away from instruments in each of the AML's three different types of spaces. By isolating mechanical systems above and away from experiments, the AML's design will improve vibration control within the lab modules, provide for regular maintenance without disturbing sensitive instruments, and improve the safety and productivity of research. (Drawings or models of the planned AML appear to have two floors rather than one in the instrument and cleanroom areas due to this added level for mechanical systems. Though reducing net/gross floor space, such features increase the flexibility of the labs for future use and help prevent obsolescence.)

Summary of Spending Plans for AML

(Dollars in thousands)

	1994-1997[a]	1998[b]	1999[b]	2000	2001	2002	2003	2004	2005-2006	**Total**[c]
Budget Authority	$17,000	$68,308	$40,000	$95,000	$15,000	$0	$0	$0	$0	$235,308
Obligations[d]	17,000	0	2000	196,308	15,000	0	0	0	0	235,308
Outlays	17,000	0	240	24,436	30,302	34,948	67,136	37,208	24,038	235,308

[a] Funds were obligated in FY 1994

[b] Funds will not be obligated until FY 2000 when contract will be let for the construction of the AML.

[c] Includes both the $17 million already spent on design and the $218.3 million needed to complete the project

[d] Modifies the obligations planned for FY 1999 and FY 2000 as reflected in the President's Budget and the Department of Commerce Budget in Brief.

Air-Handling and Temperature Control

The extra floor for mechanical systems is also necessary due to the large volume of air that must be drawn through the building spaces to achieve the required temperature, humidity, and air quality. Temperature control for most areas of the instrument and clean-room wings will be ± 0.25 degree Celsius. Laboratories requiring control to ± 0.10 degree Celsius or ± 0.01 degree Celsius will be located in the metrology areas. These labs will be configured as "rooms within rooms" and will have dedicated air-handling units. These levels of temperature control have been confirmed through an extensively tested, full-scale, operating test module onsite. Achieving such temperature control depends on larger volumes of air circulating than normal to minimize temperature differences in various parts of a room. This means that instruments cannot be "packed to the rafters" as is typically the case in today's smaller NIST laboratories. Sensitive instruments must have sufficient open space surrounding them to maintain even temperatures throughout the room.

Those projects with the strictest temperature stability requirements will need to be controlled to better than ± 0.01 degree Celsius. These projects typically involve precision dimensional metrology where the slightest expansion of a material due to a temperature change will degrade measurements. Even projects requiring ± 0.1 degree Celsius control will entail fabricating special enclosures for instrumentation. These instruments will be controlled remotely since even an operator's body heat can change measurements substantially.

Usable Floor Space

While the "footprint" of the AML on schematic drawings of the NIST campus looks large, the actual "net assignable square meters" is substantially less than it appears. This large "footprint" is a cost-effective method to meet the critical environmental demands. Two areas are below grade and three are above grade, but none of the five areas includes more than one floor of laboratory space. The total "net assignable" space in the AML is about 19,500 square meters (210,000 square feet.) About 13,000 square meters (140,000 square feet) of the building is research laboratory and office space—an area about 1½ times the area currently provided by one four-level Gaithersburg General Purpose Laboratory.

However, for a variety of reasons, fewer projects will be able to occupy this space than occupy equivalent square meters in the current General Purpose Labs. These reasons include: greater space needs (estimated at about 20 percent) for the precise temperature control described above, greater space to allow access to people with disabilities as required by codes not currently met in NIST's labs (estimated at 6 percent), and the fact that some of these projects will need substantially more space than currently available due to building enclosures and remote access rooms (needed for monitoring and controlling experiments) to achieve even tighter controls than the base building provides.

Spending and Construction Plans

The table above shows NIST's project spending plans for the AML for both budget authority and outlays. Excluding $17 million already spent to pay for the building design, NIST estimates that construction of the AML will cost $218.3 million. The $108.3 million currently in hand along with the $95 million requested in FY 2000, total the $203.3 million needed for the construction. An additional $15 million will be needed in FY 2001 for post-construction fit-up, relocation, and communications.

NIST received prices for the AML construction as currently designed as part of a 1996 procurement that was cancelled due to a rescission of funds. Booz·Allen and Hamilton also validated the cost estimates for the AML prepared by NIST. In addition, NIST has used its experience in construction of the Advanced Chemical Sciences Laboratory—to be occupied in March 1999—to help verify cost estimates for the AML. BAH estimated that the AML will cost between $209 million and $256 million.

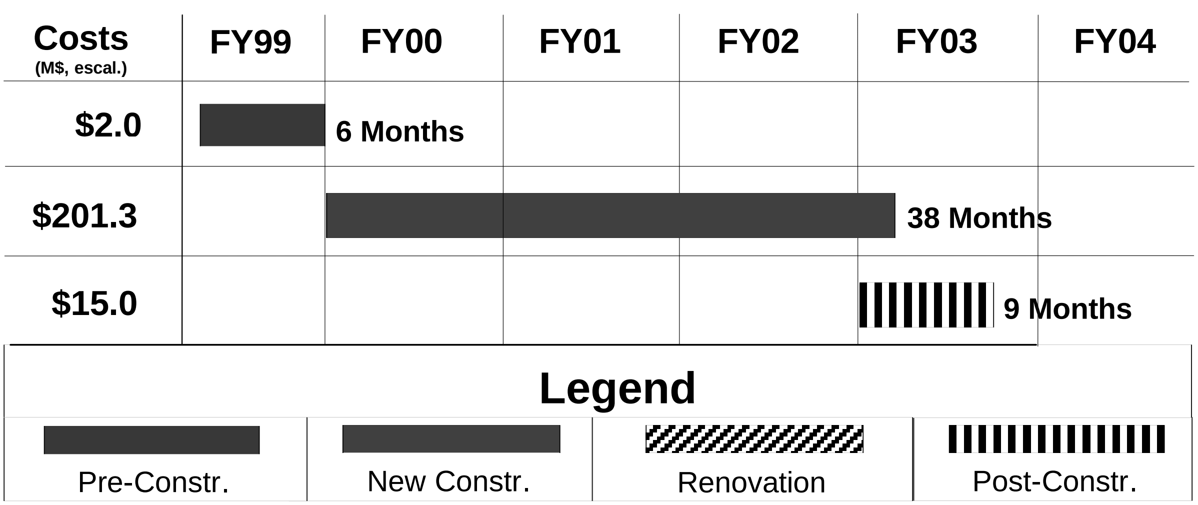
Included below is a construction plan for the AML project. This plan assumes that NIST will begin pre-construction activities before April 1, 1999. These pre-construction activities will include an update of the AML design (completed in 1996) and procurement preparations required up to the point that requests for bids would be made.

The following are milestones for FY 1999 through FY 2003 for the AML project:

FY 1999 - NIST plans to complete all preconstruction activities during this period of time. All construction documentation will be updated to meet current program and code requirements. Acquisition plans will be completed and procurement will be initiated for all consultant and construction contracts to ensure NIST is in position to award these contracts in FY 2000.

FY 2000 - Foundations for all sections of the AML building, including the exterior permanent retaining wall for Metrology East (see schematic diagram) and Metrology West; 30 percent of the superstructure; 28 percent of the mechanical work; 14 percent of the

Advanced Measurement Laboratory - Gaithersburg, MD



Pre-Construction: Project scope definition and goals (cost, schedule, and performance) development, organization and staffing, procedures development, management systems (to monitor and control costs, schedule and quality/performance), development and implementation procurement planning for consultant and construction contracts, development, procurement and negotiation of consultant contracts, architectural programming, design, estimating, scheduling, migration planning, and permitting.

New Construction or Renovation: The time from the award of the construction contracts to the point of substantial completion of the "base" laboratory facility, at which time fit-up, relocation, and communications activities may commence in earnest.

Post-Construction: Fit-up (final lab-by-lab design and construction necessary to allow the researchers to hook-up their program-specific equipment and make use of the base lab); relocation (of existing and new equipment); hook-up of laboratory equipment, and telecommunications planning; design, and construction.

Summary of Spending Plans for Safety, Capacity, Maintenance, and Major Repair projects*

(Dollars in millions)

	FY98	FY99	FY00	FY01	FY02	FY03	FY04
Budget Authority	$16.7	$16.7	$11.8	$16.8	$16.8	$16.8	$16.8

* as described in the President's FY 2000 budget.

electrical work; 39 percent of general construction needs such as scaffolding, insurance, bonding, and miscellaneous construction rental equipment will be completed.

FY 2001 - NIST estimates that the superstructure and skin enclosure for all AML sections will be completed. All of the AML will be in weather-tight condition (enclosed with exterior surfacing to protect the interior from the weather.) By the end of FY 2001, NIST estimates that 35 percent of interior construction, 52 percent of conveying systems such as elevators, 63 percent of mechanical systems, 50 percent of electrical systems, 9 percent of commissioning (testing and inspection of building equipment functioning) 9 percent of sitework, and 65 percent of general construction needs will be complete.

FY 2002 - Installation of the AML's movable interior wall panels and all laboratory casework (built-in laboratory furniture/fixtures) would be completed. By the end of FY 2002, the AML construction would be substantially complete with only minor items remaining: 3 percent interior construction, 4 percent commissioning, 5 percent sitework, and 2.6 percent general construction needs.

FY 2003 - In FY 2003, NIST plans to complete the AML base building project and the fit-up, relocation, and communications work needed to prepare and install instruments and related equipment in specific lab and office modules.

Maintenance Priorities

For FY 2000, NIST has requested $106.8 million for construction of research facilities (CRF). Ninety-five million dollars of this amount will be used for construction of the AML as described above and $11.8 million is slated for safety, capacity, maintenance, and major repair projects (SCMMR). NIST's FY 1999 budget includes $16.7 million in SCMMR projects that are currently under way. In addition, the budget assumes that during FY 1999 NIST will spend an additional $10 million on SCMMR projects (using funds provided in FY 1998) to address compounding systems failures in Gaithersburg and Boulder that are directly interfering with the conduct of research activities.

Projects included in this category of funding are related to keeping NIST's current buildings in good working order, providing a safe working environment, or delivering sufficient and reliable utilities and other services to laboratories. Normal day-to-day maintenance costs are not included in this category.

NIST consistently has placed the safety and health of its employees and visitors as its highest facilities improvement priority. In addition, NIST sites suffer from systems capacity problems such as inadequate ability to deliver chilled water to high-technology laboratories and antiquated electrical systems. Finally, there are large numbers of maintenance and major repair projects such as replacement of 30- to 45 year-old roofs and replacement of failed emissions control systems.

Over a 25-year period beginning in 1965, appropriations for building maintenance and improvement remained essentially flat in constant dollars. At the same time, the buildings' advanced age produced a substantial backlog of urgent safety, capacity, maintenance, and major repair projects (SCMMR). Since 1993, NIST has received about $80 million in appropriations for SCMMR projects. Projects paid for with these appropriations have included installation of a fire safety sprinkler system in the 11-story Administration Building; construction of a hazardous waste materials handling facility; increased capacity for Gaithersburg's central utility plant and systems (including additional chillers, cooling tower cells, and pumping systems); upgrades to sewer lines, water lines, and electrical distribution systems; replacement of steam manholes, and structural repairs to NIST's 750-seat auditorium.

While progress has been made, only a small fraction of a backlog of needed SCMMR projects totaling about $400 million (at the end of FY 1997, in FY 1999 dollars) has been addressed. Over the next four to five years, NIST hopes to achieve a significant reduction in the most urgent components of this backlog.

Given NIST's current substantial backlog of projects, prioritization necessarily depends on an up-to-date assessment of current facility conditions. Appendix A include lists of specific projects that NIST plans to accomplish in FY 1999 and FY 2000. Projects listed under the $10 million SCMMR plan in FY 1999 would be completed first, followed by projects listed under the $11.8 million FY 2000 plan. These include a wide range of projects such as continued upgrades to fire safety systems, removal of hazardous asbestos materials, replacement of compressors or antiquated control systems and electrical switchgear, replacement of selected roofs and roads, and improved accessibility for the handicapped. Many of these projects have been deferred in previous years to the point where they present risks for safety, critical failures, or non-compliance with building codes.

Conclusion

NIST's plans for improving its rapidly deteriorating facilities remain an urgent priority for its mission of providing the best possible measurement system to U.S. science and industry. These plans include construction of an Advancement Measurement Laboratory for the most technically demanding areas of NIST research and for continued attention to critical safety, capacity, maintenance and major repair work to ensure the health and safety of NIST staff and visitors and to keep current buildings operating.

NIST has carefully documented its needs, reaffirmed its conclusions with outside consultants, cut costs substantially from its initial plans in 1992, and made every effort to continue its current research as efficiently and effectively as possible. Implementation of NIST's facilities improvement plans—including approval for construction of the Advanced Measurement Laboratory beginning as soon as possible in FY 2000—will ensure that NIST can provide the world-class research and results that U.S. industry and science need to compete in world markets and keep the U.S. economy growing.